# BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

## RECORD

Record 1980/74

GEORGINA RESEARCH

for the period April-September 1980

Compiled by

C.J. Simpson

Project Co-ordinator

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## Preface

During the period a BMR Record (1980/34, Microfilm MF131) was released by J.H. Shergold reviewing the advances in knowledge arising from the first five years' progress of the Georgina Basin Project since its inception in 1974. Among the advances discussed are comments on: a refinement of the biostratigraphic time scale; a greater understanding of the structural evolution of the basin; the recognition of recurring evaporite environments during deposition of some units; the identification of oil shale, hydrocarbon traces and source rocks; and new information on the thermal history of the basin. A bibliography containing the 94 papers and maps, published since 1974, or in press or preparation at 31 December 1979 is included, together with a list of the personnel involved with the Project.

The following notes contain contributions submitted by: D. Gibson, B.M. Radke, J.E. Rees, C.J. Simpson (BMR), J.J. Draper (GSQ), P.L. Harrison (AOD Pty Ltd), R.A. Henderson (James Cook Univ.), and P.N. Southgate (ANU). Contributors are identified in parenthesis at the end of each contribution.

## 1. Sedimentology

Details of epeiric carbonate sedimentation of the Ninmaroo Formation were published in the BMR Journal 5(3), 183-200. In brief, the Ninmaroo Formation is one of several epeiric carbonate sequences in the Georgina Basin. It comprises ooid, peloid, flat-pebble conglomerate, skeletal and mixed carbonate lithofacies, terrigenous sandstones, and a late diagenetic crystalline dolostone lithofacies. Ninmaroo sedimentation took place in a broad, shallow epicontinental sea under normal marine, increasingly saline, and evaporitic conditions. A barrier complex of ooid, peloid and skeletal sands formed the seaward limit of these environments. Channels through this barrier extended weak tidal effects to the periphery of an extensive non-tidal complex of semi-emergent shoals in a patchwork pattern. Here, algal and nonskeletal carbonate sedimentation predominated because higher salinities restricted the fauna. Sedimentation was cyclic, probably due to repeated shoaling from storms. Sabkhas developed locally on emergent areas of shoals and landward where the complex was transitional with an emergent pavement. Where emergence was prolonged, microkarst resulted with both carbonate and sulphate dissolution. Lithofacies patterns indicate two regressive depositional sequences. An initial southeastern progradation of the barrier and epeiric environments was over a stable and extensive flat shelf. Subsequent instability increased shelf slope locally, and depositional environments along margins were condensed. With increased tidal circulation, skeletal carbonate production became dominant, producting a second offlap to the southeast. (B. Radke, BMR)

The presence of phosphatic stromatolites in the middle Cambrian Thorntonia Limestone was reported in the pervious issue of Georgina Research. Details of the occurrence have now been published in Nature (1980). Phosphatic stromatolites had previously only been found in Proterozoic rocks, from the middle to upper Riphean Aravalli Group of Rajasthan, India and in the USSR and China. It was generally considered that phosphatic stromatolites were unique to the Precambrian.

Indeed this unique association had led to hypotheses that during the Precambrian a different set of phosphogenic processes must have existed. (P.N. Southgate, ANU).

The Ethabuka Sandstone is a recently recognised Ordovician unit in the Georgina Basin. Sublabile to quartzose sandstone with minor mudstone, siltstone, and pebbly beds crop out along the inner margin of the Toko Syncline and are intersected in the subsurface in AOD Ethabuka No. 1. It is a marine unit containing trilobites, nautiloids, pelecypods, gastropods, and brachiopods. Numerous inorganic and biogenic sedimentary structures are present. A conformable relationship exists with the underlying Mithaka Formation and the unit is overlain unconformably by either Devonian or Mesozoic rocks. The lowermost part of the unit is transgressive; this is apparently followed by progradation so it is possible that much of the upper part of the unit is non-marine. Since the Ethabuka Sandstone is lithologically similar to the Nora Formation, Carlo Sandstone, and Mithaka Formation, it is included with them in a redefined Toko Group from which the Coolibah Formation has been excluded. Definitions have been published in the Queensland Government Mining Journal for September 1980. (J.J. Draper, GSQ)

Previously unrecognised pseudomorphs of sulphate and halide minerals are widely represented in the surface outcrop of Middle and Upper Cambrian strata of the Georgina Basin, where they afford important clues in palaeoenvironmental interpretation. We have found sulphate pseudomorphs in the Middle Cambrian Thorntonia Limestone, Currant Bush Limestone, V-Creek Limestone, Mailchange Limestone and Quita Formation as well as in the early Upper Cambrian Georgina Limestone and Mungerebar Limestone. Pseudomorphs occur as moulds or replacements of gypsum and baryte crystals. Original baryte crystals are also known. Sulphate pseudomorphs are most common in chert-replaced carbonate where they occur as crystal moulds. In limestone, sulphates have usually been replaced by either calcite or dolomite. Moulds of halite in chert are known at some localities. (R.A. Henderson, James Cook Univ., P.N. Southgate, ANU).

## 2. Palaeontology

Palaeontological investigations continued on material collected from the Georgina Basin.

J.H. Shergold is currently conducting research in Germany related to Cambrian trilobites. His BMR Bulletin 186 on late Cambrian trilobites from the Chatsworth Limestone was released during the period. His investigations with D.M. Fortey (British Museum), into Cambrian-Ordovician trilobite faunas are continuing.

P.D. Kruse (Uni, of Sydney) and P.W. West (formerly ANU) released a paper on archaeocyatha from the Todd River Dolomite (Amadeus Basin) and Mount Baldwin Formation (Georgina Basin) which comprised part of the Early Cambrian platform cover of the central Australian craton. Marine dolostones of these rock units preserve a limited archaeocyathan-radiocyathan fauna. The Todd River Dolomite and Mount Baldwin Formation can be correlated with the lower part of the Ajax and Wilkawillina Limestones of South Australia. The central Australian and corresponding South Australian archaeocyathan faunas appear to be coeval with those of the Atdabanian and possibly early Lenian stages of Siberia.

P.J. Jones (BMR) and K.G. McKenzie (Riverina CAE) published a paper on new taxa, palaeobiogeography and biological affinities of Middle Cambrian Bradoriida (crustacea).

Investigations of Cambrian and Ordovician molluscs and Devonian fish are proposed.

## 3. Drilling

During the period June-August 1980 three shallow stratigraphic holes were drilled in the Georgina Basin by BMR. All holes failed to reach their proposed depths (300 m) due to interception of caves and/or loss of drilling fluid. The simplified preliminary geological logs of the holes appear below.

During September the holes were logged by the BMR well-logging crew and records for Gamma, Density, Neutron, Resistivity and S.P. were obtained.

Similar logs, as well as a Temperature log were run on BMR Mount Isa No. 1 which was drilled in November 1978 (refer BMR Records 1979/36, 1979/53).

## BMR CAMOOWEAL 2

Location: 19°43'S, 138°48'E.

40 km north of Barkly Highway, 1 km east of Yelvertoft-Thorntonia Road.

Purpose: To obtain core of the Currant Bush Limestone and Inca Shale for studies in oil shale, petroleum source rocks, and black shale; to obtain general stratigraphic and lithological information.

Simplified preliminary log:

| | |
|---|---|
| 0-2.4 m | Soil and weathered limestone. |
| 2.4-77.5 | Stylolaminate grey fine limestone, minor massive fine limestone, chert, calcareous organic shale. Generally cyclic (1-4 m cycles), with chert and massive limestone interbedded with light coloured laminated limestone at base, grading up into darker laminated limestone (i.e. more dark stylolaminae), then grading rapidly to organic rich calcareous shale, which grades very rapidly to light coloured limestone (beginning at next cycle). Organic shales generally less than 5 cm thick. Basal 3½ m slumped. |
| | Disconformity at 77.5 m. |
| 77.5-118.8 | Fine bituminous limestone, fine non-bituminous limestone; bituminous shale increasing with depth. |

| | |
|---|---|
| 118.8-119.3 | Breccia of calcareous shale in matrix of pink and green coarse dolomite. Clasts supported at top, matrix supported at base. |
| 119.3-132.4 | T.D. Vuggy dolomite and siliceous fine limestone. Pyrite rick dolomitic(?) shale beds present below 130 m. |

Suggested stratigraphy:

| | |
|---|---|
| 2.4-77.49 m | V-Creek Limestone |
| 77.49-118.83 m | Currant Bush Limestone/Inca Shale |
| 118.83-132.40 m | Thorntonia Limestone |

## BMR DUCHESS 15A

Location: 21°22'S, 139°59'E.

Burke River Crossing of Duchess - Cloncurry Road;
200m southeast of water bore (Engine Well).

Purpose: To obtain core samples of the Roaring Siltstone for studies in petroleum source rocks, oil shale, and black shale; to obtain general stratigraphic and lithological information.

Simplified preliminary log;

| | |
|---|---|
| 0-1.0 | Soil and weathered rock. |
| 1.0-95.6 | Massive to laminated fine pyritic bituminous limestone, with thin shale and siltstone interbeds. Bitumen present in vugs and cracks. |
| 95.6-105.0 | T.D. Weathered yellow, white and light grey siltstone and fine sandstone, extensively fractured and leached. Very good water supply. |

Suggested stratigraphy:

| | |
|---|---|
| 1.0-95.6 | Devoncourt Limestone |
| 95.6-105.0 | Roaring Siltstone |

BMR TOBERMORY 14

Location: 22°53'S, 137°27'E.

5 km SSW of Black Tank, Marqua Station.

Purpose: To obtain core of the Marqua Beds for studies in petroleum source rocks, black shale and oil shale; to obtain general stratigraphic and lithological information.

Simplified preliminary log:

| | |
|---|---|
| 0-1.0 | Soil. |
| 1.0-85.3 | Laminated dark grey nodular fine pyritic bituminous limestone with thin calcareous bituminous shale interbeds. |
| 85.3-86.8 | Vuggy dolomite. |
| 86.8-86.9 | Breccia-dolomite veins in massive fine limestone. |
| 86.9-101.3 | Bituminous fine limestone with thin bituminous shale interbeds, and occasional patches of coquinite(?) and bituminous coarse limestone. |
| 107.3-107.8 | Dolomite. |
| 107.8-109.5 | Fractured and calcite veined bituminous shale. |
| 109.5-116.0 | Dolomite, cherty in places, Mn dendrites. |
| 116.0-128.75 | Dolomite with increasing arkose content. Unconformity at 128.75. |

| | |
|---|---|
| 128.75-143.0 | T.D. Red-green shales |

Suggested stratigraphy:

| | |
|---|---|
| 1-109.5 | Marqua Beds |
| 109.5-128.75 | Red Heart Dolomite |
| 128.75-143 | Adam Shale |

(D. Gibson BMR)

4. Structure

During the past three years considerable effort has been directed to investigation of the structure of the southwestern margin of the Georgina Basin where reasonable exposure of Proterozoic and Palaeozoic lithologies occurs.

Results of seismic work across the Toko Syncline and the Toomba Fault Zone to the west have been reported in Georgina Research. A final synopsis of the seismic and associated geophysical investigations has been published in the September issue of the BMR Journal. The abstract for that article is reproduced below.

The Toomba Fault is a major basement fault which extends for 200 km and forms part of the southwest margin of the Lower Palaeozoic Georgina Basin. Structural data from five detailed seismic and gravity profiles over the Toomba Fault establish that it is a high-angle reverse fault, with a dip varying between $40^{\circ}$ and $70^{\circ}$ and vertical displacement up to 6.5 km. The Palaeozoic strata to the northeast of the fault are steeply upturned, overturned, or folded into anticlines or monoclines. Associated faulting varies from small-throw faults to fracture zones 4 km wide, and reverse faulting.

These data are consistent with other geological evidence that the area of the Toko Syncline was under general northerly compression during Late Devonian or Early Carboniferous time, and that right-lateral wrenching occurred along the fault, with up to 4 km of horizontal displacement. The presence of compressional features in adjoining Palaeozoic sediments indicates oblique convergence of crustal blocks during the wrenching. The area immediately east of the fault has several types of potential hydrocarbon

traps. Up to 10 km of Adelaidean strata underlie Palaeozoic sediments within the Toko Syncline and up to 3.5 km of these sediments are present west of the syncline. A near-surface low-velocity layer, up to 250 m thick, west of the Toomba Fault, and concealed by sand and alluvium, probably comprises Jurassic to Cretaceous strata. (P.L. Harrison, AOD Pty Ltd)

Field investigations along the margin of the Georgina Basin in the central region of Huckitta 1:250 000 Sheet shows that a style of faulting similar to the Toomba Fault Zone is prevalent there. The contact between Lower Proterozoic/Archaean basement and overlying Palaeozoic sediments commonly display thrust faulting with the basement overthrust onto the southern edge of the younger sediments. Thrust block movements have been to the northwest. On the western side of Huckitta sheet the thrusting gives way to transverse faulting (C.J. Simpson, BMR)

## 5. Geophysics

Study of the detailed aeromagnetic data flown by BMR in 1977 in the Glenormiston area commenced during the period. Data processing was completed to enhance magnetic features and prepare data for release through the Government Printer.

Interpretation to date has assumed a simple model with Palaeozoic (with or without Adelaidean) sediments overlying pre-Palaeozoic (?Arunta-type) basement in the west with shallower Mt Isa-type rocks as basement in the east. Northerly trending magnetic features in the centre and east of the area exhibit a high degree of correlation with trends in the Mt Isa block, and probably correspond to susceptibility contrasts within the basement. Some fold structures are also evident. Less obvious northwest magnetic trends in the centre and west of the area are probably caused by basement faulting. There is no evidence from the magnetics to confirm a significant susceptibility contrast between basement rocks in the east and west of the area. Magnetic modelling has suggested a susceptibility contrast of 0.001-0.003 between

basement and sediments with thicknesses of 300-400 m in the Northwest and Central areas, 100-200 m in the Northeast and 200-1000 m in the Southwest. Contacts dip fairly steeply to the west. The stronger magnetic anomalies in the northwest and southwest of the area may be caused by granite intrusion and/or local basement relief. Palaeozoic sediments thicken in the centre and south of the area and a closed ?basin structure in the centre is defined by stronger north-south trends truncated to the north and south by northwest faulting.
(J.E. Rees, BMR)

## 6. Maps

Abudda Lakes 1:100 000 scale preliminary geological map was released on 26.6.1980. This completes the five 1:100 000 scale sheets originally proposed for issue, namely Burke River Structural Belt, Adam Special, Toko, Abudda Lakes (BMR), and Mount Whelan (GSQ).

Detailed mapping of areas of upper Proterozoic and Palaeozoic sediments of the Georgina Basin sequences within the Jervois Range, Jinka and Dneiper 1:100 000 scale sheets (Huckitta 1:250 000 sheet) will be released when basement geology has been complied.
(C.J. Simpson, BMR)

## 7. Publications

The following papers were published during the period April-September 1980 (inclusive).

COOK, P.J., & SHERGOLD, J.H., 1980 - Proterozoic and Cambrian phosphorites of Asia and Australia - a progress report. In SHELDON, R.P., & BURNETT, W.C. (Eds.), Fertilizer Mineral Potential in Asia and the Pacific. Proceedings of the Fertilizer Raw Materials Resources Workshop, August 20-24, 1979, Honolulu, Hawaii, pp. 207-223

DRAPER, J.J., 1980 - Ethabuka Sandstone, a new Ordovician unit in the Georgina Basin, and a redefinition of the Toko Group. Queensland Government Mining Journal 81(947), 469-475.

HARRISON, P.L., 1980 - The Toomba Fault and the western margin of the Toko Syncline, Georgina Basin, Queensland and Northern Territory. BMR Journal of Australian Geology & Geophysics, 5(3), 201-214.

HENDERSON, R.A., & SOUTHGATE, P.N., 1980 - Cambrian evaporitic sequences from the Georgina Basin. Search 11(7-8), 247-249

JONES, P.J., & McKENZIE, K.G., 1980 - Queensland Middle Cambrian Bradoriida (Crustacea): new taxa, palaeobiogeography and biological affinities. Alcheringa 4(3), 203-225.

KRUSE, P.D., & WEST, P.W., 1980 - Archaeocyatha of the Amadeus and Georgina Basins. BMR Journal of Australian Geology & Geophysics 5(3), 165-181.

RADKE, B.M., 1980 - Epeiric carbonate sedimentation of the Ninmaroo Formation (Upper Cambrian-Lower Ordovician), Georgina Basin. BMR Journal of Australian Geology & Geophysics, 5(3), 183-200.

RADKE, B.M., & DUFF, P., 1980 - A Potential dolostone reservoir in the Georgina Basin: the Lower Ordovician Kelly Creek Formation. BMR Journal of Australian Geology and Geophysics 5(2), 160-163.

SHERGOLD, J.H., 1980 - Late Cambrian trilobites from the Chatsworth Limestone, Western Queensland. Bureau of Mineral Resources, Australia, Bulletin 186.

SHERGOLD, J.H., 1980 - Georgina Basin Project progress report 1974-1979. Bureau of Mineral Resources, Australia, Record 1980/34, Microfilm MF131.

SHERGOLD, J.H., & DRUCE, E.C., 1980 - Upper Proterozoic and Lower Palaeozoic rocks of the Georgina Basin. In HENDERSON, R.A., & STEPHENSON, P.J., (Eds.), The geology and geophysics of northeastern Australia. Geological Society of Australia, Queensland Division, Brisbane, pp. 149-174.

SOUTHGATE, P.N., 1980 - Cambrian stromatolitic phosphorites from the Georgina Basin, Australia. Nature, 285(5764), 395-397.

The following are in preparation, have been submitted for publication, or are in press as of 30 September 1980.

DRUCE, E.C., - The Kelly Creek Formation and its conodont faunas, Georgina Basin, Western Queensland and Northern Territory. Alcheringa.

DRUCE, E.C., - The Coolibah Formation and its conodont fauna, Georgina Basin, Queensland and Northern Territory. Bureau of Mineral Resources, Australia, Bulletin.

DRUCE, E.C., - Conodonts of the Nora Formation and Carlo Sandstone: Georgina Basin, Queensland and Northern Territory. Bureau of Mineral Resources, Australia, Bulletin.

DRUCE, E.C., SHERGOLD, J.H., & RADKE, B.M., - A reassessment of the Cambrian-Ordovician boundary section at Black Mountain, western Queensland, Australia. In Biostratigraphy of the Cambrian-Ordovician Boundary, University of Wales Press.

GREEN, P.M., - Petrology and sedimentology of the Georgina Limestone, Georgina Basin, Queensland.

JACKSON, K.S., - Petroleum source rock report - GSQ Mt Whelen 1 and 2 Queensland Government Mining Journal.

KENNARD, J.M., - The Arrinthrunga Formation, Upper Cambrian epeiric carbonates in the Georgina Basin, central Australia. Bureau of Mineral Resources, Australia, Bulletin 211.

RADKE, B.M., - Lithostratigraphy of the Ninmaroo Formation (Upper Cambrian-Lower Ordovician), Georgina Basin. Bureau of Mineral Resources, Australia, Report 181, Microfilm 153.

RADKE, B.M., - Model for cyclic sedimentation in epeiric carbonates of the Georgina Basin. Proceedings and Abstracts Australian Sedimentologists Group Conference 1980.

RADKE, B.M., - Late diagenetic history of the Ninmaroo Formation, Georgina Basin, Central Australia. BMR Journal of Australian Geology & Geophysics.

RADKE, B.M., - Sabkha overprint in the Ninmaroo Formation (Upper Cambrian-Lower Ordovician) Georgina Basin. Journal of Sedimentary Petrology.

RADKE, B.M., & MATHIS, R.L. - On the formation and occurrence of saddle dolomite. Journal of Sedimentary Petrology 50(4).

SANDSTROM, M.W., - Organic geochemistry of a Cambrian phosphorite. In Advances in organic geochemistry, 8.

SHERGOLD, J.H., - Idamean (late Cambrian) trilobites, Burke River structural belt, western Queensland. Bureau of Mineral Resources, Australia, Bulletin 187.

SHERGOLD, J.H., COPPER, R.A., DRUCE, E.C., & WEBBY, B.D., - Synopsis of selected sections of the Cambrian/Ordovician boundary in Australia, New Zealand and Antarctica. In Biostratigraphy of the Cambrian-Ordovician Boundary, University of Wales Press.

SIMPSON, C.J., WALTER, M.R., WILKINS, R.W.T., & RUSSELL, N., - Mineralisation of the Hay River area, Northern Territory.

TURNER, S., JONES, P.J., & DRAPER, J.J., - Early Devonian thelodont remains and associated fauna from the Cravens Peak Beds, Toko Syncline, western Queensland. BMR Journal of Australian Geology and Geophysics.

WALTER, M.R., - Adelaidean and Early Cambrian stratigraphy of the south-western Georgina Basin: correlation chart and explanatory notes. Bureau of Mineral Resources, Australia, Report 214, Microfilm MF92

WALTER, M.R., - Late Proterozoic tillities of the southwestern Georgina Basin Australia. In HARLAND, W.B., (ed). Pre-Pleistocene tillites: a record of the Earth's glacial history.

WARREN, R.G., - Geology and tectonic setting of the eastermost outcrops of the Arunta Block. Bureau of Mineral Resources, Australia, Record.